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Added effect of yoga-based exercise program on balance and fear of fall in chronic post-stroke hemiparetics

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ABSTRACT

Background and aims

The purpose of the study was to find out the added effect of Yoga-based exercise program alongwith conventional balance exercises on balance and fear of fall in chronic post-stroke hemiparetics. Balance in stroke patients is affected due to decrease in muscle strength, myotonus changes, sensory defect, abnormal posture reaction, and cognitive problems, and lack of central integration of somtosensory, vestibular and visual sensory inputs. Yoga has been known to improve strength in voluntary muscles and has an effect of somatosensory system.

Methods

An experimental study was carried out On 10 stroke patients picked through purposive random sampling in Talegoan Dabhade, 5 in the control group were given conventional balance exercises and 5 were given added Yoga exercises including asanas and pranayama(breathing exercises) for 4 weeks, 4 sessions per week. Pre and post outcome measures: POMA for balance and FES for fear of fall were taken.

Results

There was more improvement in POMA scores with a p-value of 0.01039 and FES scores with p-value 0.01739 in the experimental group which is statistically significant and hence favours the study.

Keywords: Yoga, Balance, Asanas, Conventional exercises.

INTRODUCTION

A stroke, or cerebrovascular accident (CVA), results in a sudden, specific neurological deficit and occurs when a brain blood vessel is either occluded by a clot or bursts. It is the suddenness of this neurological deficit- occurring over seconds, minutes, hours or a few days-that characterizes the disorder as vascular. [1]

CVAs can be classified according to pathological type- thrombosis, embolism, or hemorrhage-or according to temporal factors, such as complete stroke, stroke-in-evaluation, or transient ischemic attacks. (TIA) [1]

The incidence of stroke rises rapidly with increasing age: two thirds of all strokes occur in people older than 65 years, and after the age of 55 years, the risk of stroke doubles every 10 years. [1]

Stroke is one of the leading causes of death and disability in India. The estimated adjusted prevalence rate of stroke range, 84-262/100,000 in rural and 334-424/100,000 in urban areas. The incidence rate is 119-145/100,000 based on the recent population based studies. [2]

What is chronic stroke?

The persistence of neurological deficits after a cerebro-vascular accident for 6 or more than 6 months is called chronic stroke.

CLINICAL FEATURES

Weakness and loss of control and Balance

Diminished muscle strength, either paralysis or weakness is an important category of impairment. It differs from generalized weakness and orthopedic weakness; it involves one entire side of the body. Postural control and balance are disturbed following stroke with impairments in alignment, stability, symmetry and dynamic balance common. Balance impairments may exist when reacting to a destabilizing external force (reactive postural control) and/or self initiated movements (proactive or anticipatory postural control). Thus, the patient may unable to maintain stable balance in sitting or standing to move in the posture without loss of balance [1]

Hypotonicity or Spasticity

Hypotonic muscles offer no resistance to passive movement and are clinically associated with paralysis and weakness. Clients who have had a severe stroke may have no visible movement in the extremities; the extremities display no resistance to passive movement and feel heavy.

Spasticity

Increased velocity dependant response to stretch- clasp knife phenomenon. Additionally, secondary problems like joint dysfunction, pain, and undesirable compensatory movements may result.

Loss of alignment

Weakness of the trunk on one side results in flaring of rib cage and lateral flexion of spine with the convexity on the affected side.

Pain

Owing to the imbalance of muscles, improper movement patterns, joint dysfunction, improper weight-bearing pattern and muscle shortening.

Gait and Locomotion

Gait is altered following stroke owing to a number of factors. Either due to loss of balance and postural control, or due to the weakness of muscles, or tightness owing to spasticity.

BALANCE AFFECTION POST-STROKE

Balance damage can develop due to limited range of motion, muscle atrophy, myotonus change, sensory defect, abnormal posture reaction, and cognitive problems [3]. Balance disorder causes problems of movement, decreases recovery of daily activities, and increases risk of falling [4]. A lack of central integration of somatosensory, visual, and vestibular sensory inputs is one of the most important causes of balance disorder in patients with stroke. Central integration of sensory input refers to mobilizing other potential sensory system in case one of the sensory inputs is missing or insufficient in order to overcome the insufficient sense. [5]

Yoga

'Yoga' is derived from the Sanskrit root verb 'yuj' which is translated to mean unite implying an emphasis on the union of mind, body and spirit [14]. For the purpose of this study, yoga is interpreted to mean a set of practices that include adapted low intensity exercises (asana), breathing practices (pranayama) and meditation. As a form of therapy yoga can be adapted to meet the needs of individuals with various limitations and offers an alternative to conventional exercise interventions by including methods of relaxation and awareness of movement, breathing and thoughts. Postures in yoga are thought to strengthen voluntary muscles and control over the autonomic nervous system. [6]

Usually post-stroke balance is affected in patients due to muscular weakness leading to altered weight distribution patterns; less weight is taken through weak leg and decreased sensorimotor ability. Yoga has been found to increase flexibility, agility, strength, muscle tone, motor coordination, breathing patterns, blood flow and body

temperature. But, the effect of Yoga on improving Balance has less evidence in Chronic Stroke. Yoga has been studied in various neurological conditions, like multiple sclerosis, parkinsons disease.

With Yoga since there is a coordinated action of agonists (prime Movers) and Antagonists (counter-acting muscles), so there is a phenomenon of reciprocal inhibition which perpetuates motor coordination, therefore it improves motor function and so its added effect on improving balance with chronic stroke patients needs to be studied. Also, Yoga is least expensive, simple to understand, widely acceptable and easy to be performed under all circumstances. [7]

METHODOLOGY

- **Study design**- experimental study
- **Sampling**- purposive Random Sampling
- **Sample Size**-5,5
- **Sampling Population**- unilateral Stroke patients having balance problems and fear of fall in Pune and Talegoan region.
- **Inclusion criteria**- 6 months and beyond unilateral stroke patients.
- POMA score>18 –moderate risk of fall.
- Minimum MMSE >24 in a 30 total score scale. [8]
- Both Genders included Females post 3 months delivery.
- **Exclusion criteria**- were unable to ensure transportation to the sessions, or had a self-reported medical contraindication (serious cardiac conditions, serious chronic obstructive pulmonary disease or oxygen dependence, and musculoskeletal diseases, a history of significant psychiatric illness, uncontrollable diabetes with recent weight loss) [8]

MATERIALS REQUIRED

- Paper
- Yoga Mat
- Quiet room
- Pen

Outcome measures

- POMA- performance oriented mobility assessment: assessment of static and dynamic Balance. [9]
- MODIFIED FALL EFFICACY SCALE: assessment of Fear of fall. [10]

Methods and procedures

An experimental study was conducted in chronic stroke patients with POMA scores>18 and MMSE>24 in both male and female population, in Talegoan Dabhade. The subjects were made to understand the nature and purpose of the study. Every subject was given consent form prior to study. Subjects data, demographic factors, Outcome measures were taken pre and post the study.

Procedure

- 10 patients participated in the research study. They were divided into 2 groups-

Group A

Consists of 5; This is the control group, i.e this group continued their regular PT treatment (for reducing tone, for improving sensory function, interventions to improve flexibility and Joint integrity, interventions to improve and improve upper and lower limb function with gait training):

Rx; active movements upper limb, lower limb functional activities of the hand strengthening upper limb, lower limb tone inhibition, stretching, balance training.

- They were also given: conventional treatment2 to increase Balance which includes:

CONVENTIONAL EXERCISES	
WEEK 1	**WEEK 3**
Wide stance EO: EC	progress to
narrow stance EO:EC	balance board exs
tandem stance EO:EC	lateral step-up and step-down
sit to stand EO:EC	braid walking
wide BOS walking	walking on uneven surfaces or foam
narrow BOS walking	
sideways walking.	

WEEK 2	WEEK 4
progress to marching EO:EC step-up and step-down EO:EC multidirectional functional reach hurdle walking,backward walking	progress to swiss ball excs PNF braid walking

GROUP 2

Or the case group will comprise 5 people. They will receive the routine Physiotherapy treatment and the conventional Balance training just like the control group. Other than that, they will also receive Yoga-based exercise program for 4 weeks, 16 sessions. 4 sessions in a week and the exercises progressed from seated to standing to floor or mat table. The following protocol is given [9]

WEEK 1: 2: 1 breathing slow rhythmic breathing excs Pranayam : Anulom Vilom, Om, Brahmari. warm up: neck ROM b/l Shoulder active ROM excs Spinal flexion, extension, lateral flexion and rotation	**WEEK 3-4** FLOOR OR MAT OR TABLE paschimottasana u/l knee to chest b/l knee to chest bhujangasana savasana
WEEK 2-4: hip rotation and stretching with ankle, foot and toes and range of motion (KAPOTASANA) hand to opposite knee STANDING: tadasana knees bent up toes locust pose veerbhadrasana: warrior pose utkatasana	**WEEK 4:** repeat. Increase the duration of holds.

Figure 1: Kapotasana

Figure 2: Hand To Opposite Knee

Figure 3: Utkatasana

Figure 4:

Figure 5:

Figure 5:

Figure 6: BHUJANGASANA

Analysis and interpretation of data

Table 1: demographic data

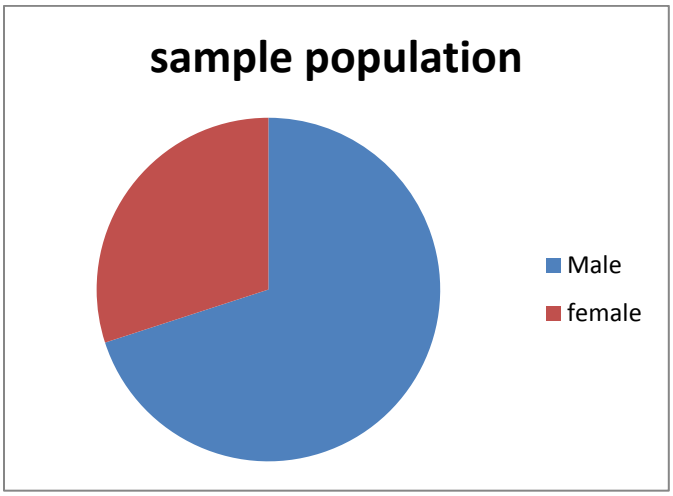
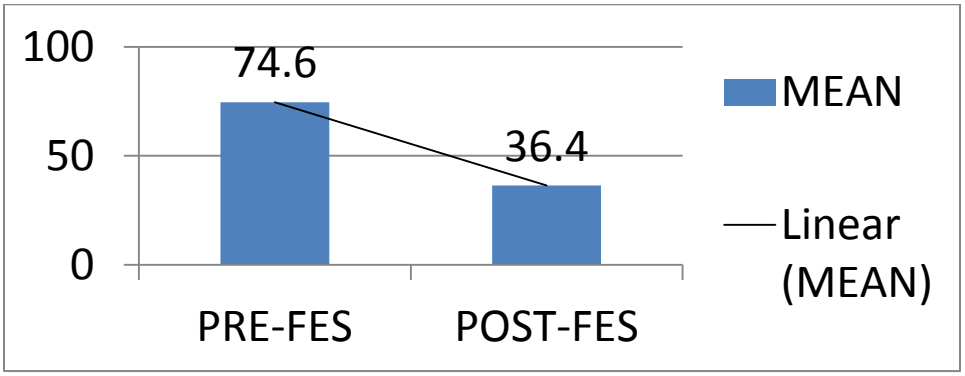


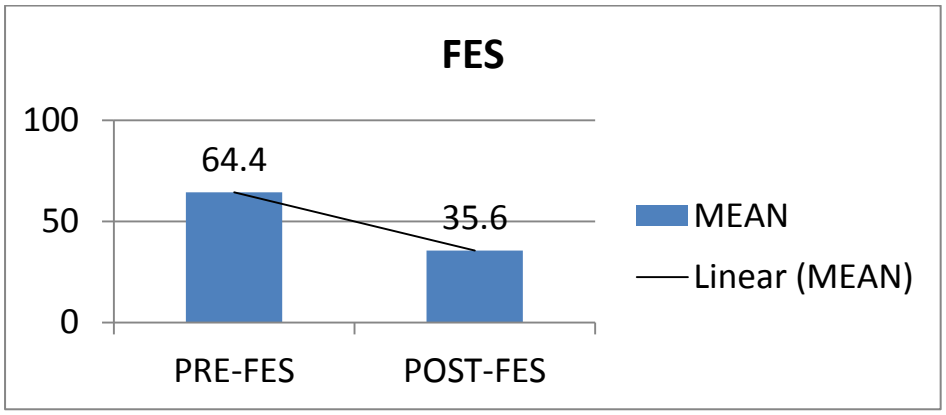
Table 2: pre and post fes

	CONTROL	EXPERIMENTAL
PRE-FES	64.4	35.6
POST-FES	74.6	34.6

Added-effect of yoga on fear of fall using fes.

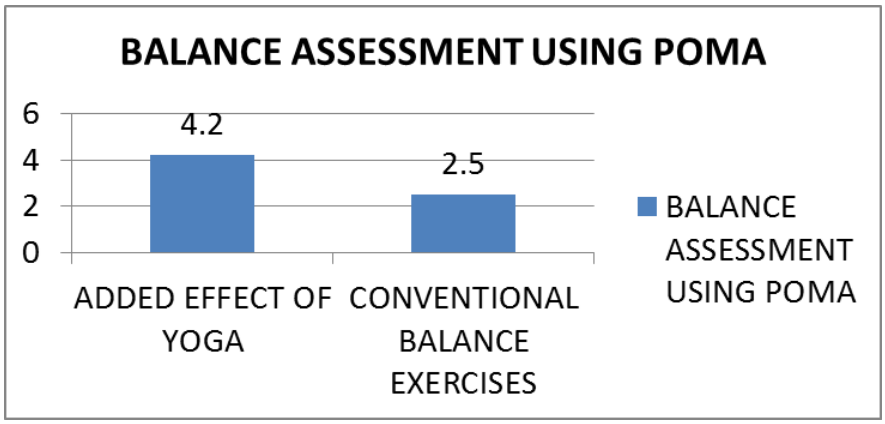


Effect of conventional balance exercises on balance on fear of fall in stroke patients

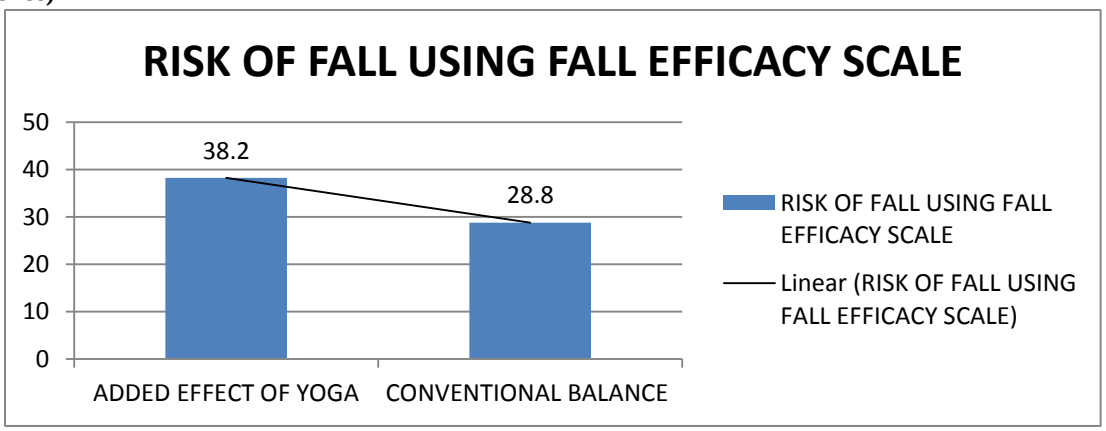


With added effect of Yoga along wth conventional exercises pre and post Fall Efficacy Scale scores were taken, the value of u is 25 and with conventional balance exercises also the value of U is 25, which gives a p value of 0.004, which is significant.

Effect on balance with yoga and conventional program and just conventional program. (difference)



Effect on risk of fall with yoga alongwith conventional exercises and just conventional balance exercises. (difference)



Since, both the data's are statically significant, a comparison of both will help in deciding which is better. For the comparison of added-effect of yoga along with conventional exercises versus just conventional exercise on balance The t-value is -5.21356. The p-value is .000404. The result is significant at $p < .05$. Similarly, when the control and experimental group values are compared for the fear of fall component, the u-value is 5.5. The p-value is 0.1739, which is not statistically significant at $p<0.05$.

DISCUSSION

The results obtained are in the favour of the study were proved by authors like Ariene Schmidt, 2012: "Poststroke Balance Improves with Yoga: A Pilot Study" which suggested that a group yoga-based rehabilitation intervention for people with chronic stroke has potential in improving Multiple poststroke variables. Group yoga may be complementary to rehabilitation, may be possible in medical-based and community-based settings, and may be cost-effective. Yoga may be especially effective in improving function poststroke, because it promotes coordination of complex movements, balance, strengthening, and breathing.[8]

Also, a systemic review by the Chapman Universities shows the studies of various authors and the improvement of Balance post Yoga-intervention. [11] yoga has shown to improve strength and muscle force.[11] In regards to the stroke population, increased muscle force may allow for greater musculoskeletal control leading to better balance and mobility. [11]

In the chair pose, UTKATSANA (fig 3) there is an activation of gluteus maximus along with counterbalancing forward tilt of the pelvis for stabilizing the trunk structures. [12] Also, there is an activation of longissmus thoracis and external oblique muscles. Reduction in electromyographic anticipatory postural activation was also noted in lattismus dorsi and external oblique muscles of the affected side in a study by Suruliraj Karthikbabu et al. [13] Also, the study suggests that leg muscles may assist in stabilizing the trunk in the antero-posterior direction whereas lateral sitting balance almost completely depends on trunk muscles. UTKATASANA also targets generally the Quadriceps, Hamstrings, Gluteus Maximus, Gastrocnemius, Tibialis Anterior, Soleus and other muscles in lower extremities. Like in the mountain pose, TADASANA, co-contracion of Rectus Ab0dominis and Longissmus Thoracis was seen to stabilize the lumbopelvic hip segment. The two mountain poses with hands up (hip flexed and calf raised) are designed to elevate the back, open the pelvic region, and compress the ribcage to increase stabilization. [14]

In the warrior pose, Trikonasa, the hip and knee of the dominant and non-dominant sides were respectively flexed and extended, while the spine was kept extended. When the front leg was flexed, the back-leg Gluteus Maximus was activated to extend and externally rotate the hip producing a very high activity level. This pose could be an effective tool for increasing Gluteus MAximus strength. But, also with spine extension there was low level activation of Longissmus THoracis, which would develop endurance and reduce fatigue. [12] This could be a reason why the

paitents withstand the nudged component of POMA.

In the BHUJANGASANA pose, the hip is extended and internally rotated, and the trunk is hyper-extended. This exercise also targets the Gluteus maximus and lower extremity improving the single-limb support component. [15] This back extension pose stretches the anterior aspect of trunk muscles and mobilizes the posterior trunk musculature. Also, there is a high activation of External Oblique Abdminis and upper and lower fibres of Rectus Abdominis. Also, since the pose in maintained by the upper extremity, theres co-contraction of biceps, triceps and the shoulder musculature, improving upper limb stability.

Medical Yoga Therapy by Ina Stephens [16] claims that yoga practices seem to be effective by bringing the parasympathetic and sympathetic systems into balance (often by increasing parasympathetic tone and decreasing sympathetic firing), and does this in large part by increasing GABA activity [17]. Studies have shown that GAB Aergic inhibitory interneurons result in cortical inhibition which has been implicated in improved cognitive performance and enhanced emotional regulation capabilities [18]. Multiple studies have shown that the practice of yoga and meditation may work as well as other therapies in increasing GABA levels in the brain [19]

In POMA, in the balance components, patients have shown an improvement in the nudged [6] component, turning 360 degrees and continuous steps [8], this could be due to an improvement in the muscles controlling the ankle strategy. According to Ki Heyon Park et al, The effects of ankle strategy exercises on unstable surfaces on dynamic balance and changes in the COP [20], An ankle joint strategy is one in which the balance is maintained through a little movement with appropriately four actions that occur at the ankle joint; dorsiflexion, plantar flexion, inversion, and eversion. To control trunk postures, the central nervous system receives information from the feet and integrates the surrounding environment to receive information using ascending neural pathways [21]. Ankle joint plantar flexion is regarded as a core control mechanism in standing [22]. Involving the gastrocnemius, the soleus, and the tibialis anterior, plantar flexion serves the function of balance control in response to ground reaction forces [23] and plays an important role in gait efficiency. As a solution for balance problems, the treatment of abnormal muscular contraction or proprioceptive deficit through the reeducation of ankle movements has been reported to be important [24].

Also, in Gait component in Yoga, step symmetry, step continuity and path have shown improvement, due to the improvement in Hip abductor strength and lateral trunk musculature strength as seen in Virabhadrasana, BHujangasana and setubhandasana.

RESULTS AND CONCLUSION

The added-effect of Yoga along with conventional exercises on balance as compared to just conventional balance exercises gives a statistically significant results, hence is in favour of our study. However, the effect of Yoga along with conventional balance exercises on fear of fall is similar as just conventional balance exercises. Hence, accepting Null Hypothesis.

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